

WEST VIRGINIA
DIVISION OF HIGHWAYS

DIVISION 700
MATERIALS
CONTROL

CONSTRUCTION
MANUAL

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Section 701

PURPOSE AND IMPORTANCE OF CONTROL OF MATERIALS

701.1 GENERAL

A successful highway construction project depends on proper initial planning and scheduling. Prior to construction, carefully consider each major construction phase as it relates to the overall project — what activities need to be performed; who will be responsible for the activity; when will the activity need to begin and end relative to other activities; what if any special equipment or procedures will be required; etc. During this process, it is very important to include the activities related to material quality control and assurance.

The West Virginia Division of Highways (WVDOH) is ultimately responsible for assuring the quality of all materials used in its highway construction projects. It is important that these materials be controlled and monitored uniformly to achieve an acceptable level of quality in the highway project. The importance of this action is two-fold:

1. The public will be assured of receiving the full benefit of tax dollars expended toward highway construction; and
2. A uniform basis of bidding is offered to all Contractors who want to participate in highway projects, either financed with State or a combination of State and Federal funds.

WVDOH publishes its Quality Control/Quality Assurance (QC/QA) procedures and criteria primarily in the **Standard Specifications** (including Supplemental Specifications and Special Provisions) and **Materials Procedures**. Obtain these and related documents from the Materials Control, Soils and Testing Division. Division 700 of this **Manual** provides additional guidance. It is essential that project personnel from both the Contractor (e.g., Project

Superintendent, Forman) and WVDOH (e.g., Project Engineer/Supervisor, Inspector, District Materials Supervisor) reference these documents frequently to become familiar with and uniformly apply correct procedures and criteria.

Material quality is a primary concern from project start to finish. Sampling, testing, inspection, and approval duties are integral parts of the project's day-to-day activities. WVDOH is primarily responsible for quality assurance. Personnel from the Contract Administration Division, the Engineering Division, and the District will perform their respective duties to verify the quality of material provided by the Contractor and either accept or reject the material at the source, upon delivery, or as placed in the project. The Contractor is primarily responsible for quality control, which includes using pre-approved and certified materials and monitoring and adjusting material production and placement to achieve a level of quality specified by WVDOH.

701.2 COMPLIANCE WITH SPECIFICATIONS

An adequate and effective system for control of materials used in a project is absolutely essential to ensure that the materials furnished and the work performed by the Contractor conform, or reasonably conform as permitted, with the requirements of the plans and specifications.

Control of materials includes: inspection, sampling, testing, and measurement of materials and processes; reporting of procedures and results; and performing any necessary follow-up activities, especially in cases of test failures. If any one of these actions is ignored, the Project Engineer/Supervisor cannot completely or accurately verify whether or not the Contractor

is in compliance with the plans and specifications.

701.3 UNIFORM RELATIONS WITH CONTRACTORS

Because the plans and specifications define the minimum requirements that WVDOT expects of the Contractor, they provide an equitable basis for bidding on the project prior to letting the contract. Each prospective bidder has the opportunity to commit to furnishing materials and completed work that will equal or exceed the specified minimum requirements.

The Project Engineer/Supervisor is responsible, through materials control measures, for verifying that the Contractor is at least meeting the specified minimum requirements and that WVDOT is receiving what it is entitled to under the contract. To do otherwise not only would be a disservice to the State but also an undue advantage to the winning Contractor. Other Contractors, having bid on the same project, could contend that they would have offered a lower bid knowing that materials and work below minimum requirements would be acceptable to WVDOT.

Project Engineers/Supervisors and Inspectors are responsible for treating all Contractors and their material suppliers equally by exercising materials control activities uniformly from project to project. Misunderstandings and interpretation differences will hinder this objective. As such, WVDOT prepares its project plans and specifications to be as clear and concise as practical. Division 700 of this **Manual** provides additional guidance on how to interpret the specifications relative to control of materials.

701.4 DOCUMENTATION FOR EXPENDITURE OF PUBLIC FUNDS

701.4.1 Documentation and Payment

Prior to paying the Contractor for materials furnished and work performed, WVDOT requires sufficient documented evidence to support the expenditure. Project personnel use a materials control process, established by the Contract Administration Division, to collect and document this evidence on a day-to-day basis. Through this process, the Project Engineer/Supervisor will acquire sufficient data (e.g., test results, inspection records, field measurements) to substantiate acceptance of the Contractor's work, thus assuring WVDOT that the Contractor has fulfilled its contractual obligations and is entitled to full payment. Upon receipt of such documentation, responsible WVDOT officials can legitimately authorize payment to the Contractor.

701.4.2 Daily Reports

Inspectors and Project Engineers/Supervisors respectively use the Inspector's Daily Report (Form 442-IDR) and Supervisor's Daily Report (Form 442-SDR) to collect data on the daily activities and environs of the project. Form 442 contains many supplemental attachments to document specific project activities. See the Appendix for a complete example of Form 442. These Daily Reports provide a permanent written record of the project as not all project data is entered into the Project Records System.

701.4.3 Project Records System (PRS)

The Project Records System (PRS) is a microcomputer database management system developed by the Contract Administration Division. Project Engineers/Supervisors and Inspectors use PRS on a daily basis at the Project Field Office to record and manage data and report on the delivery, testing, placement, and payment of all materials received and placed

on the project. Information that is entered into PRS is obtained primarily from the Daily Reports (i.e., Form 442).

701.4.4 Contract Administration File System (E440)

Project Engineers/Supervisors periodically upload PRS files from their respective Project Field Offices to the Contract Administration Division's mainframe computer. The Materials Control, Soils and Testing Division validates the PRS files and merges the data with the Division's Contract Administration File System (E440).

701.4.5 Weekly Suppliers Report (Form 441)

Material sources that furnish materials to one or more projects are responsible for completing and submitting Weekly Suppliers Reports (Form 441) to the District Materials Supervisor. See the Appendix for a complete example of Form 441. The District Materials Supervisor is responsible for entering pertinent information from Form 441 into the Division's Contract Administration File System (E440).

701.4.6 Laboratory Numbers

The Division's materials control process uses an index called a laboratory number to track the test results of materials furnished by the Contractor. Without a laboratory number, the process cannot ascertain whether or not the material has been approved for use on the project. Therefore, it is very important that the Inspector, prior to accepting delivery of the material, check the shipping document to ensure it originated at the point of manufacture (i.e., not the supplier) and that it contains the appropriate laboratory number, project number, and authorization. Record the laboratory number with other pertinent information on the Daily Report. See MP 700.00.01 for additional information on sampling and testing materials at the source.

701.4.7 Basis for Acceptance

Data managed by the materials control process constitutes the Division's basis for accepting or rejecting the materials furnished and the work performed by the Contractor, and ultimately for approving or denying payment to the Contractor. In cases where the Contractor does not meet the specified minimum requirements, this data may be used to negotiate a contract price adjustment with the Contractor if the Division chooses to use the data as a basis for acceptance. It is therefore extremely important to maintain complete and accurate project records (e.g., test procedures and results, laboratory numbers, inspection reports) at all levels including the Project Field Office, the District, and the Contract Administration Division.

Section 702

GENERAL PROCEDURES FOR MATERIALS CONTROL

702.1 APPLICATION OF SPECIFICATIONS

WVDOH determines the acceptability of all construction materials prior to their use in highway projects. Division personnel will inspect, sample, and test the materials and compare the results to the minimum requirements of the contract specifications. The WVDOH **Standard Specifications** occasionally references test procedures developed by national organizations such as the American Association of State Highway and Transportation Officials (AASHTO) and the American Society for Testing and Materials (ASTM). Reference books of the AASHTO and ASTM material and testing specifications are maintained in the Project Field Office, the District Office, and the Central Office in the Materials Control, Soils and Testing Division. The **Standard Specifications** also reference specific WVDOH materials and testing procedures (e.g., MP 700.00.01). Contact the Materials Control, Soils and Testing Division for a copy of the **Materials Procedures**.

702.2 FORM 454

To expedite material inspection, sampling, and testing, the Contractor will use Form 454 to inform the Project Engineer/Supervisor of all proposed material sources, including those supplied by any subcontractors. The Contractor will list separately on Form 454 each proposed source for the types of material required by the contract. Any known WVDOH pre-approved and certified material sources and/or mix designs (e.g., asphalt concrete, PCC) should be included on the Form. If a source or mix design has not been pre-approved and certified by the Division, the Contractor will list the sources of all raw materials to be used in production.

Ensure that the source's physical address is included on Form 454. Post office boxes (i.e., P.O. Box) are not acceptable.

Desirably, the Contractor will submit Form 454 to the District before the Pre-Construction Conference; otherwise, the Contractor must bring it to the Conference. The District will cross-reference the types of materials listed on Form 454 with those materials specified in the contract and inform the Contractor of any omitted items. Upon District approval, the District will forward one copy of Form 454 each to the Contract Administration Division and the Project Engineer/Supervisor. As soon as practical, the Contractor should forward letters to its suppliers advising them that WVDOH will test all materials for acceptance prior to delivery to the project. Immediately after the Pre-Construction Conference, the Materials Control, Soils and Testing Division will verify that each supplier listed on Form 454 has been prepared.

The Contractor will include on the initial Form 454 all anticipated material sources for plant production and field operations. An updated Form 454 will only be required if the Contractor anticipates using a different or additional material source or mix design during construction. If a pre-approved and certified mix design is to be used on the project, the Contractor should use the laboratory number of the pavement mix rather than listing individual material components of the mix on Form 454.

702.3 STANDARD PROCEDURES AND THE INSPECTOR

To objectively determine whether or not a material meets the minimum requirements of the **Standard Specifications**, it is critical to perform the procedures consistently each time.

To achieve this objective, WVDOH references or publishes standardized procedures that are based on either national industry standards or the previous experience of Division personnel in highway construction. These standardized procedures are frequently referenced in the **Standard Specifications** as ASTM and AASHTO testing and materials specifications or WVDOH **Materials Procedures**. See Section 702.1 for additional information on the application of contract specifications.

Inspectors at the plant or on the job site are in the best position to pass judgment on whether or not project materials meet the requirements of the contract specifications. Inspectors ensure that each tax dollar is spent to the full benefit of the public and that all Contractors and suppliers are treated objectively. Inspectors ensure that the Contractor has a WVDOH approved Quality Control Plan and that the Contractor and its suppliers are operating within that Plan. If the Division decides to use the Contractor's quality control tests as acceptance criteria for particular contract items, Inspectors ensure that the Contractor's personnel are qualified, that they sample and test the material based on the standardized procedures of the contract specifications, and that they properly document the test results.

702.4 DUTIES OF THE INSPECTOR

702.4.1 Inspector's Daily Report (Form 442-IDR)

The Inspector is responsible for ensuring that all materials delivered to the project have complete and accurate shipping documents and are identified with appropriate WVDOH laboratory numbers. The Division requires that all materials be inspected, sampled, tested, and approved before they are used on the project. Reject materials that are delivered without laboratory numbers. To expedite the approval process, note the point of inspection if different from the source. Visually inspect all materials to ensure they are delivered in good condition, and reject

materials that are obviously damaged from shipping and handling. The arrival of all materials must be properly documented. Document the following information on the Inspector's Daily Report (Form 442-IDR):

1. description of material;
2. quantity of material;
3. source of material;
4. contract item for which the material is to be used;
5. any test data information (e.g., laboratory numbers, inspection and identification markings, shipping documents);
6. location, condition, and storage of the material; and
7. any other relevant information.

If an unusual material or requirement is identified in the contract plans and specifications, attach a note calling attention to the special condition on any sample of material forwarded to either the District Materials Supervisor or the Materials Control, Soils and Testing Division.

702.4.2 Evidence of Inspection

It is extremely important to properly determine and document the acceptability of all construction materials before they are used in the project. Use the publication **Evidence of Inspection** to identify for each contract pay item the material involved, coverage type, evidence of inspection, and method of documentation required. Contact the Contract Administration Division to obtain this publication. If a delivered material fails to meet the requirements of **Evidence of Inspection** or is otherwise questionable, the following actions will be taken:

1. The Inspector will immediately notify the Project Engineer/Supervisor of the situation.
2. The Project Engineer/Supervisor will request the Contractor to furnish the applicable test data or to sample and test the material as may be required by the **Standard Specifications**.
3. The Project Engineer/Supervisor will enlist the aid of the District Materials Supervisor on any problems with materials sampling and testing and/or documentation that cannot be satisfactorily resolved with the Contractor.
4. Upon receipt and approval of the required test data, a determination of materials acceptability will be made.

702.4.3 Quality Control Plan

For some contract pay items, the Division requires the Contractor to submit a Quality Control Plan for review and approval. For those items that require a Quality Control Plan, do not assume that all material sampling and testing activities are the Contractor's responsibility. There usually exists some division of responsibilities between WVDOT and the Contractor. The Contractor is typically responsible for material sampling and testing activities associated with materials quality control, while the Division is responsible for those activities associated with the quality assurance of materials. The Inspector, and ultimately, the Project Engineer/Supervisor is responsible for ensuring that the Contractor is operating within the sampling and testing requirements of the Quality Control Plan. If the Contractor's samples and tests are to be used as part of the Division's material acceptance procedure, ensure that the Contractor's quality control sampling and testing procedures are in compliance with the procedures established by WVDOT (e.g., see MP 307.00.50 for guidelines on base course test procedures, see MP

401.03.50 for guidelines on bituminous concrete test procedures).

702.5 GENERAL INSTRUCTIONS FOR SAMPLING AND TESTING

Numerous types of materials are used in WVDOT highway construction projects. Each material has specific inspection, sampling, and testing procedures established by the Division to assess material quality and acceptability. It is very important to completely understand these procedures and requirements. By understanding how to treat a particular material upon its arrival at the job site, the Inspector can minimize construction delays and better assess material quality.

Use the material inspection and source approval procedures documented in Section 106 of this **Manual**. If it is not practical to follow these procedures for a particular lot of material, notify and obtain approval from the Project Engineer/Supervisor before any quantity of material from that lot is used in construction work. See Figure 703A for the minimum required sample locations, sample and test frequencies, sample sizes, and test procedures for particular types of materials. Some samples may need field testing while others may need shipped to the laboratory for testing. Use Figure 703A in conjunction with the **Standard Specifications**, **Materials Procedures**, and ASTM and AASHTO specifications. These references describe the details of the procedures. Note that changes in standardized sampling and testing procedures (e.g., Supplemental Specifications) may apply during the project.

702.6 VISUAL INSPECTION

Although a material will be approved for use and identified with a WVDOT laboratory number before it is shipped to the job site, examine each shipment as soon as practical after it is received to identify any damage or undesirable change that may have occurred from

shipping and handling. As practical, inspect all material that will be stocked on site while it is being unloaded. This is especially important for relatively large and brittle items such as reinforced concrete pipe. Just prior to their use or placement, conduct a final visual inspection of all materials. If a condition arises that could prevent the material from meeting the contract specifications or otherwise result in unsatisfactory performance, contact the Project Engineer/Supervisor for approval before allowing the Contractor to use the material in the project. See Section 106 of the **Standard Specifications**.

702.7 IDENTIFICATION OF SAMPLES

For the Division to properly assess the acceptability of a particular type and lot of material, each sample must be processed correctly. An improperly or incompletely identified sample is worthless and may cause a delay in construction. Ensure that complete identification of the sample is provided on a properly executed Form T-100 (Test Sample Data) and that the completed Form T-100 is shipped with the sample. Forward Form T-100 to the District Materials Supervisor prior to submission to the Materials Control, Soils and Testing Division. The District will review Form T-100 and obtain information needed for its files before a formal submission is made. Division project personnel will assign the laboratory number to all samples taken at the job site by either WVDOT or the Contractor.

702.8 MATERIAL REJECTED ON THE PROJECT

If the Division rejects a lot of material on the basis of acceptance sampling and testing, inform the Contractor to set the lot of material aside and notify the Project Engineer/Supervisor of the situation. Under certain circumstances, material lots and/or sublots that do not initially conform to contract specifications may be eligible for reworking or partial replacement with Division acceptance based on the outcome of further

sampling and testing. For example, if a lift of suitable embankment at optimum moisture content fails to meet the minimum density requirements of the contract specifications, it may be practical for the Contractor to rework the lift and resubmit a new sample for further acceptance testing.

Through visual inspection and acceptance testing, it is extremely important to ensure that project materials meet the requirements of the contract specifications. Do not permit the Contractor to use obviously substandard or damaged materials without first resolving the matter with and obtaining approval from the Project Engineer/Supervisor.

Districts will cooperate fully with the Materials Control, Soils and Testing Division to obtain Independent Assurance (IA) samples and to resolve any identified dissimilarities.

Section 703

REQUIRED SAMPLES AND TESTS

703.1 GENERAL

The Division requires that a material's quality be verified prior to using the material in construction. The Project Engineer/Supervisor is responsible for ascertaining that each material has been tested and found to comply with the contract specifications. Under the Division's pre-sampling and pre-testing program and in accordance with the procedures described in MP 700.00.01, most manufactured material products will be pre-approved for use as delivered to the job site. However, the Division may require additional sampling and testing before the material is incorporated in the project. For job control purposes, consider materials that are delivered with proper identification markings and documentation in accordance with MP 700.00.01 as having been adequately sampled and tested. Such materials typically will not require additional sampling and testing. Do not permit the Contractor to incorporate in the project any material that does not have a proper inspection identification marking or laboratory number. Immediately inform the Project Engineer/Supervisor of the situation. The Project Engineer/Supervisor will ascertain whether or not the material complies with the contract specifications and will recommend an appropriate action. Materials that require additional sampling and testing at the job site, whether pre-approved or not, will be sampled and tested according to the criteria presented in this Section.

703.2 MINIMUM SAMPLING AND TESTING REQUIREMENTS

Figure 703A presents the Division's minimum sampling and testing criteria (e.g., sample locations, sample and test frequencies, sample sizes, test procedures) for various types of

construction materials. See Section 106 of this **Manual** for additional information on control of materials.

703.3 DENSITY TESTS

See Sections 704, 706, and 707 of this **Manual** for density test requirements for aggregates, bituminous materials, and embankments and backfill, respectively.

703.4 INDEPENDENT ASSURANCE (IA) SAMPLING AND TESTING PROGRAM

As part of the WVDOH Quality Assurance Program for aggregates, asphalt, and concrete mixes, the Division has established an Independent Assurance (IA) sampling and testing program. Under this program, individuals not having a direct responsibility for quality control or acceptance will independently sample and test project materials to generate a separate and distinct set of test results. The Division will use IA samples and tests to objectively judge the reliability of samples and tests used for acceptance, and not to directly determine the quality or acceptability of material and workmanship.

Depending on the required procedure, an IA sample may be a portion taken from the sample used for acceptance or a separate sample taken in close proximity to the sample used for acceptance in both time and space. IA samples are evaluated according to the procedure described in MP 700.00.53 "Procedure For Evaluating Independent Assurance Samples with Acceptance Samples."

703.5 ACCURACY AND PRECISION IN TESTING

All sampling and testing of materials must be conducted uniformly using standardized procedures to properly compare the results not only to the contract specifications but also to the results of other tests. A test is called repeatable if one person obtains nearly identical results from testing two specimens, each derived from the same sample, using the same test equipment. A test is called reproducible if two people using different test equipment obtain nearly identical results by each testing a specimen derived from the same sample. Material sampling and testing methods established by WVDOT (e.g., **Materials Procedures**) and national organizations (e.g., AASHTO, ASTM) have been developed so that they not only will be repeatable and reproducible but also will produce accurate and precise results. Accuracy means that all test results are close to true value. Precision means that all test results have nearly the same value, which may or may not be the true value. For a test to be both repeatable and reproducible with accurate results, the test equipment that is specified in the sampling and testing procedure must be used in the specified manner. For example, if a concrete cylinder is tested in a compression machine that is operated at a speed higher than that specified by the procedure, the measured compressive strength will be higher than the true value. The test results may be precise, but they will not be accurate.

MATERIAL	SAMPLE LOCATION	MINIMUM FREQUENCY	SAMPLE SIZE	SAMPLE TESTING	REMARKS
AGGREGATES (Quality Check)					
Commercial Sources	At Source (Sampled by MCS&T Division)	Sampled and tested annually.	75 – 125 lbs (35 – 60 kg)	Tests conducted by MCS&T Division. (See Note 4)	For sampling method, see MP 700.00.06.
	At Intermediate or Final Destination (Sampled by field personnel.)	One sample per each 10,000 tons (10 000 Mg) or 5,000 yd ³ (4 000 m ³) of material used for project(s).	Refer to MP 700.00.06.	Tests conducted by field personnel. (See Note 3)	For sampling method, see MP 700.00.06.
Local Sources	At Production or Storage Site (Sampled by field personnel.)	One sample per each six days of production.	Refer to MP 700.00.06.	Tests conducted by MCS&T Division. (See Note 4)	For sampling method, see MP 700.00.06.
	At Production or Storage Site (Sampled by field personnel.)	One sample per each six days of production.	Refer to MP 700.00.06.	Tests conducted by field personnel. (See Note 3)	For sampling method, see MP 700.00.06.
AGGREGATES (Gradation Check)					
Base Course, Subbase, and Shoulders	Typically sampled from the roadway prior to compaction. (See Note 9)	One sample per each half day of operation or as specified in the Contractor's approved Quality Control Plan.	Refer to MP 700.00.06.	Gradation (See Note 1)	Refer to MP 700.00.06.
Portland Cement Concrete	See Remarks.	One sample per each day of operation.	Refer to MP 700.00.06.	Gradation and Total Solids (See Note 1)	Refer to MP 700.00.06 and MP 601.03.51
Misc. Items (bedding, backfill around pipe culverts, underdrains etc.)	Project Stockpile or Production Site	One sample per each half-day of operation or stockpiling.	Refer to MP 700.00.06.	Gradation (See Note 1)	Refer to MP 700.00.06.
Misc. Items (subgrade, select material for backfilling)	Project Stockpile or Production Site	One sample per each day of production or shipment unless otherwise specified.	Refer to MP 700.00.06.	Gradation (See Note 1)	Refer to MP 700.00.06.

MINIMUM SAMPLING AND TESTING CRITERIA
Figure 703A

MATERIAL	SAMPLE LOCATION	MINIMUM FREQUENCY	SAMPLE SIZE	SAMPLE TESTING	REMARKS
AGGREGATES (Density and Thickness Check)					
Base Course and Subbase	Roadway	DENSITY: One sample per each working-width layer per 2,000 ft (600 m) (lot size).	As required by governing test procedures.	Conformity with 80% to specified target percent of dry density.	Divide the “lot” into five approximately equal size sublots and randomize location of density tests.
		THICKNESS: One sample per each working-width layer per 1,200 ft (350 m).	As required by governing test procedures.	(See Note 1)	Measure after all fine grading operations are completed and randomize location of thickness tests.
ASPHALT MATERIAL					
Performance Graded Binders	(See Note 2)	(See Note 5)	1 qt (1 L)	(See Note 1)	Refer to AASHTO T 40 for sampling techniques and procedures.
Cutback Asphalts	(See Note 2)	(See Note 5)	1 qt (1 L)	(See Note 1)	Use a can with a cork-lined screw cap or other suitable container. The lid must provide an airtight seal. Refer to AASHTO T 40.
Asphalt Emulsion	(See Note 2)	(See Note 5)	1 gal (4 L)	(See Note 1)	Use a glass or plastic container. Do not use a metal can. Refer to AASHTO T 40.
HOT-MIX ASPHALT					
Quality	Plant, Truck or Roadway	Refer to MP 401.02.27.	Sufficient size to comply with nominal aggregate size for each test.	% Asphalt, % Air Voids, % VMA, % Stability, Flow, and Gradation (As required.)	Refer to AASHTO T 168 for sampling techniques and procedures.
Density	Roadway	Refer to MP 401.05.20 and Section 401 of the Standard Specifications .	One per lift per 1,000 ft (300 m). Average of five additional tests if a single test fails. -OR- Minimum of one test section per lift.	Determine density 92% to 96% of design maximum density.	Refer to MP 401.05.20 for lot-by-lot density testing.
				Determine number of roller passes for maximum density.	Refer to MP 401.05.20 for roller pass density testing.

MINIMUM SAMPLING AND TESTING CRITERIA
(Continued)
Figure 703A

MATERIAL	SAMPLE LOCATION	MINIMUM FREQUENCY	SAMPLE SIZE	SAMPLE TESTING	REMARKS
BRICK					
Brick	(See Note 2)	Each Shipment	10 Bricks	(See Note 1)	Measure depth, width, and length. Also, refer to AASHTO T 32.
ICE CONTROL					
Calcium Chloride	—	—	—	—	Manufacturer's certification for quality and gradation.
Sodium Chloride	—	—	—	—	Manufacturer's certification for quality and gradation.
CONCRETE CURING MATERIALS					
Liquid White Membrane	See Remarks (See Note 2)	—	—	—	Accepted by approved (certified) list of sources only.
White Polyethylene Sheeting	Project Site	Each Shipment	—	Physical Appearance	Visually inspect condition.
Burlap	Project Site	Each Shipment	—	Physical Appearance	Visually inspect condition.
Waterproof Paper	Project Site	Each Shipment	—	Physical Appearance	Visually inspect condition.
CONCRETE DECK PROTECTIVE TREATMENT					
Boiled Linseed Oil and Petroleum Spirits (natural spirits) (50%-50% Mixture by volume)	(See Note 2)	Each Batch	1 qt (1 L)	(See Note 1)	Use a plastic or glass container. Before sampling, sufficiently agitate original container to ensure mixture is homogeneous.
PORTLAND CEMENT CONCRETE PAVEMENT					
Cores	Job Site	See Remarks.	See Remarks.	Compressive Strength and Pavement Thickness	For sampling and testing requirements, see Section 501.4.5 and Section 501.19 of the Standard Specifications and applicable Special Provisions.
Cylinders	Job Site	See Remarks.	See Remarks.	Compressive Strength (For opening to traffic)	For sampling and testing requirements, see Section 501.4.4 of the Standard Specifications .

MINIMUM SAMPLING AND TESTING CRITERIA**(Continued)****Figure 703A**

MATERIAL	SAMPLE LOCATION	MINIMUM FREQUENCY	SAMPLE SIZE	SAMPLE TESTING	REMARKS
PORTLAND CEMENT CONCRETE — Continued					
Mixture	Job Site	One per 500 yd ³ (380 m ³). Minimum of two per day.	—	Consistency	(See Note 1)
	Job Site	One per 500 yd ³ (380 m ³). Minimum of two per day.	—	Air Content	(See Note 1)
	Job Site (as appropriate)	One for each five days of operation after the first five days of operation.	—	Yield	(See Note 1)
STRUCTURAL CONCRETE					
Concrete Cylinders	Job Site	For each class of concrete delivered and placed on a calendar day from a single supplier, one set for each 100 yd ³ (75 m ³) or fraction thereof.	—	Compressive Strength (See Remarks.)	(See Note 6) (See Note 7) (See Note 10)
Mixture	Job Site	BRIDGE SUPERSTRUCTURE: One per first batch. One for every five batches thereafter. OTHER STRUCTURAL CONCRETE: One per 100 yd ³ (75 m ³). Minimum of one per half-day of operation.	—	Consistency	—
Mixture	Job Site	BRIDGE SUPERSTRUCTURE: One per batch. OTHER STRUCTURAL CONCRETE: One per 100 yd ³ (75 m ³). Minimum of one per half-day of operation.	—	Air Content	—
Mixture	Plant or Job Site (as appropriate)	One for each ten sets of cylinders after the first ten.	—	Yield	—

MINIMUM SAMPLING AND TESTING CRITERIA
(Continued)
Figure 703A

MATERIAL	SAMPLE LOCATION	MINIMUM FREQUENCY	SAMPLE SIZE	SAMPLE TESTING	REMARKS
FENCING MATERIAL					
Post (Metal)	(See Note 8)	—	—	—	Refer to MP 608.02.50.
Chain Link	(See Note 8)	—	—	—	Refer to AASHTO M 181.
Farm Field Type	(See Note 8)	—	—	—	Refer to AASHTO M 279.
Woven Wire Farm Fence	(See Note 8)	—	—	—	Refer to AASHTO M 181.
Barbed Wire	(See Note 8)	—	—	(See Note 1)	Refer to AASHTO M 280.
GUARDRAIL					
Posts	(See Note 8)	—	—	—	—
Steel Beam	(See Note 8)	—	—	—	—
Bolts, Nuts, and Washers	(See Note 8)	—	—	(See Note 1)	Refer to ASTM A 325 (ASTM A 325M).
Hardware	(See Note 8)	—	—	—	Refer to AASHTO M 30, and T 65M/T 65.
JOINT MATERIALS					
Joint Materials	(See Note 2)	Each Shipment	(See Note 1)	(See Note 1)	—
LANDSCAPING					
Fertilizer	(See Note 2)	See Remarks.	See Remarks.	(See Note 2)	Refer to MP 700.05.10.
Seed	—	—	—	—	Manufacturer's certification.
NUTS, BOLTS, AND WASHERS (Structural Steel)					
Nuts, Bolts, and Washers (Structural Steel)	Manufacturer and Project Site. (See Note 8)	—	All Sizes	(See Note 1)	Initially pre-approved, field RCT and Turn-of-Nut verification required by proper documentation.
PAINT					
Paint	(See Note 2)	Each Batch	1 qt (1 L)	(See Note 1)	—

MINIMUM SAMPLING AND TESTING CRITERIA
(Continued)
Figure 703A

MATERIAL	SAMPLE LOCATION	MINIMUM FREQUENCY	SAMPLE SIZE	SAMPLE TESTING	REMARKS
PIPE					
Cast/Ductile Iron	(See Note 8)	—	—	—	Project Engineer should make visual inspection of each type, size, and condition.
Clay	(See Note 2)	Each Shipment	(See Note 1)	(See Note 1)	Project Engineer should make visual inspection of each type, size, and condition.
Concrete	(See Note 2)	Each Shipment and Diameter	(See Note 1)	(See Note 1)	Project Engineer should make visual inspection of each type, size, and condition.
Corrugated Metal and Sectional Plates (Coated or Uncoated)	(See Note 8)	—	—	(See Note 1)	Project Engineer should make visual inspection of each type, size, and condition.
STEEL BEARING PILE, SHEET PILE, CAISSON PIPE					
Steel Bearing Pile, Sheet Pile, Caisson Pipe	(See Note 8)	—	—	—	Refer to MP 616.14.50.
PORTLAND CEMENT					
Portland Cement	(See Note 2)	See Remarks.	See Remarks.	(See Note 1)	Refer to AASHTO T 127 for sampling techniques and procedures.
REINFORCING STEEL					
Reinforcing Steel Bars (Black and Epoxy Coated)	(See Note 8)	—	—	(See Note 1)	Refer to MP 709.01.50 and MP 709.01.51.
Welded Wire Fabric	(See Note 8)	—	—	(See Note 1)	Refer to AASHTO M 55M/M 55.
WATER					
Untreated Water Supplies (Lakes, Ponds, Streams, Wells, etc.)	At Source	Once every three months.	1 qt (1 L)	(See Note 1)	Inspect sources periodically for visual evidence of quality change. Refer to AASHTO T 26.
Municipal Water Supplies	From water tap or other convenient location.	—	—	—	Verify source of water supply.

MINIMUM SAMPLING AND TESTING CRITERIA**(Continued)****Figure 703A**

MATERIAL	SAMPLE LOCATION	MINIMUM FREQUENCY	SAMPLE SIZE	SAMPLE TESTING	REMARKS
WATERPROOFING FABRIC					
Waterproofing Fabric	—	Each Shipment	—	—	Manufacturer's certification.
WELDER QUALIFICATIONS					
Welder Qualifications	See Remarks.	See Remarks.	See Remarks.	See Remarks.	Refer to MP 615.20.00.
COMPACTION CONTROL					
Embankments	See Remarks.	One per subplot per 2,500 yd ³ (1 900 m ³).	As required by procedures.	Moisture and Density (See Note 1)	Acceptance on a lot-to-lot basis. Refer to MP 700.00.50.
Subgrade	—	One per subplot per 400 ft (120 m) per working width.	As required by procedures.	Moisture and Density	Acceptance on a lot-to-lot basis. Refer to MP 700.00.50.
Backfill	See Remarks.	One per subplot per specification requirement.	As required by procedures.	Moisture and Density	Acceptance on a lot-to-lot basis. Refer to MP 700.00.50.

Notes:

1. Refer to the governing section of the contract documents.
2. Unless otherwise specified, take samples at the point of delivery if the material has not been previously sampled and tested by the WVDOT Materials Control, Soils and Testing Division. Certain material sources consistently demonstrate an ability to supply acceptable products. WVDOT periodically samples and tests products from selected material sources and, if acceptable, will designate the source as approved and certified. Contact the Materials Control, Soils and Testing Division for an updated list of approved and certified material sources (e.g., mills, terminals). Unless otherwise specified, if the Contractor provides sufficient documentation to substantiate that a material has been supplied by an approved and certified source, accept the material for use upon delivery to the project site (i.e., no further sampling and testing is required). Otherwise, further sampling and testing may be required. The Project Office should maintain an up-to-date list of all approved and certified material sources that are applicable to the project.
3. Conduct all tests required by the contract documents except for the following: Los Angeles Abrasion (LA), soundness, mortar strength, organic impurities, and deleterious content (analysis optional). The tests may include, but will not be limited to, the following: Atterberg Limits (liquid limit, plastic limit, and plasticity index), percent crushed particles (single-face and multiple-face fracture), unit weight, and others as specified.
4. The WVDOT Materials Control, Soils and Testing Division will test for the following: Los Angeles Abrasion (LA), soundness, deleterious content, mortar strength, and organic impurities.
5. Unless the shipment is certified or pre-tested, take one asphalt sample per shipment at its point of delivery. An asphalt shipment is considered certified if it is shipped from a WVDOT approved and certified material

MINIMUM SAMPLING AND TESTING CRITERIA
(Continued)
Figure 703A

- source. Contact the Project Office or Materials Control, Soils and Testing Division for an updated list of approved and certified material sources. A shipping document will accompany each pre-tested asphalt shipment. A laboratory number will appear on the shipping document from which the asphalt material's test results can be obtained. As needed, use this laboratory number to confirm the acceptability of the material.*
6. *The following procedures apply to all quantities of Portland cement concrete from A1 plants and all quantities of miscellaneous concrete, as defined by IM 18, from A2 plants. If sufficient plant production exists, the WVDOT Materials Control, Soils and Testing Division will obtain a minimum of ten randomly selected samples from plant production and test for compressive strength, air content, and consistency. Yield will be determined from one of the ten samples. For a minimum of four of these samples, the batching operation at the plant will be observed to check operational control and to obtain aggregate samples for gradation testing. If plant production is insufficient to fulfill these requirements, however, the Materials Control, Soils and Testing Division will obtain one sample per two days of operation, minimum, and test for compressive strength, air content, and consistency. One yield test will be conducted for every ten samples. For a minimum of 40% of the samples, but no more than four times per month, the batching operation at the plant will be observed to check operational control and to obtain aggregate samples for gradation testing. For testing in either A1 or A2 plants, project personnel may substitute observations of the Contractor's quality control tests in lieu of the testing normally required by Figure 703A, except that occasional testing may be performed on the project to monitor the Contractor's program. In the event that the Contractor's quality control testing does not provide sufficient data to meet the requirements of Figure 703A, additional testing will be performed by the Division to complete the minimum frequency required.*
 7. *The sampling frequency and tests for structural concrete also apply to Portland cement concrete pavement, where coring is considered impractical, and to all structural items constructed with pavement concrete (e.g., approach slabs), if authorized in the contract specifications.*
 8. *Do not accept material delivered to the job site unless the shipment has a corresponding WVDOT approval number. In such cases, contact the WVDOT Materials Control, Soils and Testing Division for resolution or disposition. Refer to the "Evidence of Inspection List," which is updated annually and available in each District office, for the contact person within the Materials Control, Soils and Testing Division and the material's required acceptance criteria.*
 9. *Unless specified otherwise, the Project Engineer may approve sampling at an alternate point if the following conditions are met: a) The material is taken from a conveyor belt or pug mill and hauled directly to and incorporated into the job with samples taken from the conveyor belt or pug mill discharge; b) The sampling procedure is in accordance with MP 700.00.06; and c) Sufficient data is developed to assure that the test results of samples taken from the alternate point do not differ significantly from the test results of samples taken from the roadway.*
 10. *Form, cure, and ship to the laboratory all concrete test cylinders in accordance with MP 601.04.20. If multiple suppliers deliver multiple classes of structural concrete to the project on a calendar day, apply the minimum sampling frequency to each supplier's total daily quantity of each class of concrete delivered. The laboratory will determine strength based on the average results of testing three concrete cylinders received from the field. However, if one of the three test cylinders shows manifest evidence of improper sampling, forming, curing, or testing, the laboratory will discard the improper cylinder and determine concrete strength based on the average results of testing the remaining two test specimens. If more than one cylinder shows manifest evidence of improper sampling, forming, curing, or testing, the laboratory will discard all test cylinders and not report concrete strength. To control the removal of concrete forms and falsework, additional concrete cylinders may be produced and tested in accordance with AASHTO T 23.*

MINIMUM SAMPLING AND TESTING CRITERIA

(Continued)

Figure 703A

Section 704

AGGREGATES

704.1 DEFINITION

Aggregates are composed of inert mineral matter, either crushed or uncrushed, which have been properly sized (e.g., sieve analysis) for the intended use. Aggregates are used for Portland cement concrete, bituminous concrete, base courses, granular backfills, surface treatments, pipe bedding, etc. See the respective sections of the **Standard Specifications** for information on aggregates materials and their application.

704.2 AGGREGATE INSPECTOR PROGRAMMED INSTRUCTION MANUAL

The Division certifies inspectors through examination. The **Aggregate Inspector Programmed Instruction Manual**, available from the Materials Control, Soils and Testing Division, is not only a study guide for the Aggregate Inspector Certification Examination but also a practical guide for the Aggregate Inspector to use on a day-to-day basis. The topics covered by this publication include:

1. general information on aggregate properties and characteristics (e.g., shape and surface texture, gradation, fineness modulus, Atterberg limits);
2. sampling methods and equipment;
3. sieve analysis and acceptance procedures;
4. specific gravity;
5. unit weight;
6. liquid limit, plastic limit, and plasticity index;

7. percent crushed particles and face fracture;
8. control charts and test result evaluation;
9. quality control plans;
10. conversion charts;
11. applicable **Standard Specifications, Materials Procedures**, AASHTO and ASTM sampling and testing specifications, and other industry references; and
12. other practical topics.

704.3 COMPACTION INSPECTOR PROGRAMMED INSTRUCTION MANUAL

The **Compaction Inspector Programmed Instruction Manual**, available from the Materials Control, Soils and Testing Division, is primarily a study guide for the Compaction Inspector Certification Exam. It is also a practical guide for the Compaction Inspector to use on a day-to-day basis. The topics covered by this publication include:

1. rock, soil, granular and select material types and properties;
2. placement, compaction, and testing of embankment, subgrade, backfill, treated and untreated materials, and bituminous concrete pavements;
3. optimum moisture and maximum density;
4. sampling and testing methods, procedures and equipment;

5. radiation safety procedures and operation and transport of nuclear gauges;
6. evaluation of test results;
7. rounding procedures and calculations;
8. applicable **Standard Specifications, Materials Procedures**, AASHTO and ASTM sampling and testing specifications, and other industry references; and
9. other practical topics.

704.4 COMPACTION TESTING PROCEDURES

The following WVDOH **Materials Procedures** describe in detail the Division's compaction sampling and testing procedures:

1. MP 207.07.20, "Nuclear Field Density — Moisture Test for Random Material Having Less Than 40% of 3/4" (19 mm) Material";
2. MP 307.00.50, "Guide for Quality Control and Acceptance Plans for Base Control";
3. MP 401.03.50, "Guide for Quality Control and Acceptance for Hot-Mix Asphalt";
4. MP 401.05.20, "Compaction Testing of Hot-Mix Asphalt Pavement";
5. MP 700.00.24, "Nuclear Density Test by the Roller Pass Method";
6. MP 700.00.50, "Method of Acceptance of Compaction Testing";
7. MP 712.21.26, "Procedure For Determining the Random Location of Compaction Tests"; and
8. MP 717.04.21, "Guide For Quality Control For Compaction."

704.5 AGGREGATE SAMPLING INSPECTOR PROGRAMMED INSTRUCTION MANUAL

The Division certifies inspectors through examination. The **Aggregate Sampling Inspector Programmed Instruction Manual**, available from the Materials Control, Soils and Testing Division, is not only a study guide for the Aggregate Sampling Inspector Certification Examination but also a practical guide for the Aggregate Sampling Inspector to use on a day-to-day basis. The topics covered by this publication include:

1. sampling methods and equipment;
2. sample randomization;
3. sampling procedures (e.g., roadway, conveyor belt, flowing stream, stockpile, spreader box);
4. transporting samples;
5. sampling program planning;
6. applicable **Standard Specifications, Materials Procedures**, AASHTO and ASTM sampling and testing specifications, and other industry references; and
7. other practical topics.

In addition, the following Material Procedures will apply:

1. MP 700.00.06, "Aggregate Sampling Procedures"; and
2. MP 700.00.54, "Procedure for Evaluation Process Control Test Results of Aggregate Gradations, Asphalt Mixes and Portland Cement Concrete."

Section 705

PORTLAND CEMENT CONCRETE

705.1 PORTLAND CEMENT CONCRETE INSPECTOR PROGRAMMED INSTRUCTION MANUAL

The Division certifies inspectors through examination. The **Portland Cement Concrete Inspector Programmed Instruction Manual**, available from the Materials Control, Soils and Testing Division, is a study guide for the Portland Cement Concrete Inspector Certification Examination. The Portland Cement Concrete Inspector also may use this manual on a day-to-day basis as a practical reference guide. The topics covered by this publication include:

1. concrete characteristics and relationship of properties (e.g., durability, strength, wear resistance, slump vs. air content);
2. production and operations (e.g., cement, water, air entrainment, aggregate quality, mixing, placement, finishing, curing);
3. documentation (e.g., Quality Control Plan, Form T-702);
4. sampling and testing methods, equipment, and procedures (e.g., temperature, consistency, air content, strength);
5. inspection and control (e.g., material handling, transporting and storage, plant facility, batching, mix proportioning and adjustment);
6. applicable **Standard Specifications, Materials Procedures**, AASHTO and ASTM sampling and testing specifications, and other industry references; and
7. other practical topics.

In addition, MP 601.03.50, “Guide for Quality Control and Acceptance Requirements for Portland Cement Concrete” will apply. See the applicable sections of the **Standard Specifications** for additional information.

705.2 TOTAL, ABSORBED AND FREE MOISTURE

Aggregate weight (mass) calculations for concrete batch operations are based on aggregate material in a saturated surface-dry condition. It is not practical in construction to alter aggregate material to achieve an ideal condition. However, if the amount of free moisture in aggregate material is known, it is relatively easy to adjust the weight (mass) of damp or wet aggregate to determine the correct weight (mass) of saturated, surface-dry aggregate. For practical purposes, the amount of free moisture is the difference between the percent of total moisture and the percent of absorbed moisture in the aggregate material.

In laboratory testing, determine moisture content with a precision that will achieve results that are accurate to the nearest 0.1%. Each percent of free moisture should be based on the saturated surface-dry weight (mass) of the aggregate.

For fine and coarse aggregate materials, determine the total amount of moisture as follows:

1. Determine the weight (mass) of a damp sample.
2. Dry the sample by means of heat (e.g., oven).
3. Determine the weight (mass) of the dry sample.

4. Compute the loss in weight (mass).
5. Divide the loss in weight (mass) by the weight (mass) of the dried sample and multiply by 100.

Use the following guidelines to determine the percent of absorbed moisture in aggregate materials:

1. Coarse Aggregate. For practical purposes, because it will usually amount to 1% or less, consider the percent of absorbed moisture in coarse aggregate material to be constant. Note, however, that the percent of absorbed moisture in blast furnace slag may be as much as 5%. The percent of absorbed moisture in coarse aggregate material is often assumed in production calculations. Where careful control is necessary, however, test the coarse aggregate material for absorbed moisture. The Contractor's Quality Control Plan should document the allowable percent of absorbed moisture in coarse aggregate material and how it will be determined, whether estimated or the result of moisture tests.
2. Fine Aggregate. During concrete production, perform moisture tests on fine aggregate material at least four times daily and more often when changed conditions warrant. Adjust batch weight (mass) based on the results of the tests to ensure that the maximum allowable water-cement ratio is not being exceeded and to reasonably control concrete consistency. Tests will be performed on fine-aggregate samples taken from the weigh-hopper. Ensure that the results are documented in accordance with the Contractor's Quality Control Plan.

The Contractor is responsible for submitting a Quality Control Plan for Division approval. The Inspector is responsible for ensuring that the Contractor has performed this task and is operating within the limits of the Plan.

Section 706

HOT-MIX ASPHALT (HMA) MATERIALS

706.1 HOT-MIX ASPHALT INSPECTOR PROGRAMMED INSTRUCTION MANUAL

The Division certifies inspectors through examination. The **Hot-Mix Asphalt Inspector Programmed Instruction Manual**, available from the Materials Control, Soils and Testing Division, is a study guide for the Hot-Mix Asphalt Inspector Certification Examination. The Asphalt Inspector also may use this manual on a day-to-day basis as a practical reference guide. The topics covered by this publication include:

1. fundamentals of asphalt materials and hot-mix asphalt;
2. sampling hot-mix asphalt and materials;
3. designing and testing hot-mix asphalt;
4. plant control and inspection;
5. plant setup and adjustment;
6. principles of hot-mix asphalt compaction;
7. plant mix formulas and specifications;
8. Superpave mix design system;
9. applicable **Standard Specifications, Materials Procedures**, AASHTO and ASTM sampling and testing specifications, and other industry references; and
10. other practical topics.

See the applicable sections of the **Standard Specifications** for additional information on hot-mix asphalt materials. In addition, the following WVDOT **Materials Procedures** will apply:

1. MP 106.03.50, "General Information Guide for Quality Assurance Testing";
2. MP 401.02.22, "Mix Design Testing of Hot-Mix Asphalt";
3. MP 401.02.24, "Guide to Designing Hot-Mix Asphalt with Recycled Asphalt Pavement";
4. MP 401.02.27 "Guide for Contractor Quality Control of Hot-Mix Asphalt";
5. MP 401.03.50, "Guide for Quality Control and Acceptance for Hot-Mix Asphalt";
6. MP 401.05.20, "Compaction Testing of Hot-Mix Asphalt Pavement";
7. MP 700.00.06, "Aggregate Sampling Procedures"; and
8. MP 700.00.54, "Procedure for Evaluating Process Control Test Results of Aggregate Gradations, Asphalt Mixes and Portland Cement Concrete."

706.2 COMPACTION TESTING PROCEDURES

See Section 704.3 and 704.4 of this **Manual** for information on the **Compaction Inspector Programmed Instruction Manual** and the compaction testing procedures used by WVDOT.

Section 707

DENSITY TESTS (IN-PLACE) FOR EMBANKMENT AND BACKFILL

707.1 GENERAL

Use in-place density tests to establish the degree of compaction within an embankment, backfill, or subgrade. Several methods exist for determining in-place density that may be generally categorized as follows:

1. Disturbed Method. To obtain a test sample, the disturbed method of determining in-place density requires removal of a portion of the compacted embankment, backfill, or subgrade. The volume of the test hole is calculated, and the sample's moisture content and dry weight (mass) are determined. Density is expressed as dry weight (mass) per unit volume; therefore, the in-place density of the compacted material is determined by dividing the dry weight (mass) of the sample by the volume of the test hole. The Division does not recommend the use of the disturbed method.
2. Undisturbed Method. By using the undisturbed method, the in-place density of an embankment, backfill, or subgrade can be determined without having to remove a portion of the compacted material. This method primarily employs the use of a nuclear testing device. The nuclear gauge in the device has the ability to measure the density and moisture content of the compacted material in the field without having to remove a sample for off-site testing. The Division prefers the use of the undisturbed method. Unless otherwise specified, use nuclear density testing by the roller-pass method (see MP 700.00.24).

In highway construction, determining the in-place density of a material is of little value

unless there exists a specific density for which the Contractor is trying to achieve through compaction. For a given material and application, the contract specifications will specify a target value for compaction in terms of a percentage of the material's maximum density. This percentage is commonly named percent compaction. Percent compaction is determined by comparing the in-place density of the compacted material to a standardized value for the material type. This value is commonly named maximum density. Maximum density is determined by compacting the material with a controlled and constant compactive effort at varying levels of moisture content until a point is reached at which additional moisture causes a loss in density. The moisture content at which maximum density is reached is named the optimum moisture content.

The compaction test is the only field test required to control normal earthwork. The number of density tests required depends on the amount and type of material being incorporated in the embankment within a given interval of time. Due to the various conditions that may be encountered during earthwork operations, it is difficult to establish specific criteria that will be adequate for all situations. Therefore, use sound judgment to determine the number and location of compaction tests. The Project Engineer/Supervisor will establish a random pattern of sampling and testing locations to ensure uniform and adequate test coverage (see MP 712.21.26). Use nuclear density testing by the roller-pass method for individual embankment areas of a specific material type where the lift thickness will remain constant during the test period (see MP 700.00.24). See Figure 703A for the minimum sampling and testing criteria.

707.2 EQUIPMENT

Equipment selection for density testing will depend on the type of material being tested and the method employed (e.g., disturbed method, undisturbed method). Use only equipment that is specified in the sampling and testing procedure required by the governing contract specifications.

707.3 SELECTING TEST LOCATIONS FOR EMBANKMENTS

A very important aspect of compaction testing is selecting the locations where the tests will be performed. This action is as important as reporting the final results. Although individual test results may be accurate, the overall test results of the compacted area could be misleading if test locations are improperly selected. Use the procedures in MP 712.21.26 to determine random locations for compaction testing and consider the following additional guidelines:

1. Settlement Locations. Consider establishing compaction test locations at points near the beginning of an embankment and just outside a cut area. Material settlement frequently occurs at these locations.
2. Ramps. Material used for ramps from cut to fill areas that are within the embankment section will be compacted as placed and tested for density.
3. Work Interruptions. If material placement for an embankment has been interrupted for a considerable amount of time, conduct new compaction tests to ensure no substantial change in density has occurred.

For additional information on random sampling for embankments, see the **Compaction Inspector Programmed Instruction Manual**.

707.4 COMPACTION TESTING PROCEDURES

See Section 704.3 and 704.4 of this **Manual** for information on the **Compaction Inspector Programmed Instruction Manual** and the compaction testing procedures used by WVDOH.

Section 708

MISCELLANEOUS PROCEDURES

708.1 CHECKING BATCH PROPORTIONING SCALES

708.1.1 General

It is necessary to check the accuracy of scales that are used to weigh aggregate for Portland cement concrete, Portland cement, aggregate for bituminous concrete, asphalt, and other construction materials. Department of Labor and private company scale checks that are conducted in accordance with these procedures may be observed to fulfill specified requirements. If the scale does not have 500-pound (226.75 kg) graduations, additional test weights will be used to bring the scale to an even graduation that is repeatable throughout the calibration process. The seal on a scale indicates only that the scale was accurate within certain limits under the conditions existing at the time it was tested and sealed. Collected dirt on the balance arms, damage to or wear of the knife edges settlement of the foundation, mechanical work, or authorized or unauthorized adjustment can change the accuracy of a scale from one day to the next.

Scales that are used to weigh Portland cement, aggregate for Portland cement concrete, aggregate for bituminous concrete, and related construction materials shall conform to Section 109.1 of the **Standard Specifications**.

The Contractor shall have at each batch proportioning or mixing plant at least 10 standard 50-pound (22.675-kg) weights. These weights must be kept clean and at a location that is convenient for calibrating the scales. The weigh hopper should have an attached shelf on the outside on which the test weights can be placed. If there is no such shelf on the hopper, the Contractor must furnish a cradle or platform which is to be suspended from the scale to hold

the test weights. Any equipment set up by the Contractor or plant operator must be so arranged that the scales can be checked quickly and conveniently.

When a shelf is not permanently attached to the weigh hopper, the weight of the cradle, platform, or sling used to suspend the test weights must be determined accurately by use of a small scale. This weight becomes a part of the test weight used for calibrating the scale. The Materials Control, Soil and Testing Division's document, MP 700.00.30, provides information pertaining to the calibration of the 50-pound (22.675-kg) weights.

708.1.2 Frequency of Checking and Documentation

All scales shall be checked for zero balance and sensitivity in accordance with the approved Quality Control Plan.

708.1.3 Procedure for Checking Zero Balance and Sensitivity

To check a beam scale for zero balance, slide all weights to the zero position. If the beam does not balance, either something is stuck in the weigh hopper or the scale is out of order. The trouble should be corrected before any more batches are weighed out.

In the case of a dial scale, the dial hand should return to zero after the weigh hopper is emptied. If it does not, something is probably stuck in the hopper. Before any more batches are weighed out, the reason for improper operation of the scale should be found and corrected.

The most common trouble with a scale is lack of sensitivity when the weigh hopper is loaded with the full weight of the batch. To determine the sensitivity, read the exact weight of the total batch in the hopper from the beam or dial, and then place or hang a 50-pound (22.675-kg) weight on the weigh hopper. Unless the total weight increases at least 30 pounds (13.605 kg) (49 pounds (22.222 kg) for an asphalt scale), the scale should be inspected carefully as soon as practical. The knife edges which support the scale beam may be worn or dirty, or something may be touching the lever arms, or something may be preventing the free movement of the weigh hopper. The Contractor or plant operator must keep the scales in good working order and adjustment. The Inspector should never try to fix or adjust any type of scale.

708.1.4 Procedure for Checking Accuracy

The bins should be filled when the first test is made, because the weight of the filled bins may bend the steel members to which the scale is attached and may therefore affect weighing accuracy. At a new plant, the bins should be filled before the scales are checked since the weight of the binned material may cause settlement of the foundation.

To calibrate a scale used for weighing small quantities, such as an asphalt scale, add 50-pound (22.675-kg) test weights, one at a time, to the shelf or suspending device until the total weight is slightly above the usual batch weight. For each number of weights, record the actual weight and the weight shown by the scale.

The following simplified procedure must be used for weekly checks of scales used for weighing larger quantities. Add the 10 test weights totaling 500 pounds (226.75 kg) and record the reading. Leave the test weights in place and draw the material into the hopper until the scale reading is approximately 1/3 of the total batch weight. Record this reading, remove the weights and record the reading. Continue to draw material into the hopper until the scale

reading is approximately 2/3 of the total batch weight. Record the reading, add the test weights and again record the reading. Leave the test weights in place and continue to draw material into the hopper until the scale reading is 500 pounds (226.75 kg) more than the total batch weight. Record the reading, remove the test weights and again record the reading. This check can be conducted without holding up production, and will provide a good insight into the performance of the scale.

Complete calibration should be conducted approximately every six months using the following detailed procedure: Add the 10 test weights totaling 500 pounds (226.75 kg), and record the scale reading. Remove the test weights and draw material into the hopper until the scale reads exactly the same as it did with the test weights. Leaving this material in the hopper, put on the test weights again, and record the scale reading. Remove the weights and draw more material into the hopper until the reading is the same as before. Continue this procedure until the scale reading is more than the weight of the heaviest total batch to be weighed on the scale.

708.1.5 Procedure for Checking Scales Using Load Cells

The procedure for checking zero balance and sensitivity shall be in accordance with Sections 708.1.3 and 708.1.4. If during any check a scale is found to be inaccurate, it will be calibrated by a scale company or replaced, whichever restores accuracy before use by the Division.

The procedure for checking the accuracy of scales with load cells will be modified from Section 708.1.3 as follows: The check of the scales to 25% of capacity will be 500 pounds (226.75 kg) at a time, alternating with material for test weight. The scale will then be brought to 50% capacity with material, then the test weights will be returned to determine error at this point. The test weights will be removed and material will be used to bring the scale to 75% of capacity, then the test weights will be

returned to determine error at this point. This process will be replaced at the heaviest total batch to be weighed on the scale.

708.2 CHECKING ACCURACY OF METER PROPORTIONING

708.2.1 Meters or Pumps for Bituminous Materials

Frequently check meters and metering pumps used to proportion asphalt in bituminous mixtures. If the average of several carefully run extraction tests result in a difference of more than 0.3% between the measured quantity of bituminous material and the quantity of material required by the job mix formula, halt production immediately and have the equipment checked and properly adjusted. The accuracy of meters and metering pumps may be affected by any of the following factors:

1. changes in pressure of the liquid as it goes into the meter or pump;
2. changes in temperature or penetration of the bituminous material; and
3. changes in back pressure that may be caused by partial stoppage of spray nozzles or openings in the spray bars.

Use the following guidelines when checking the accuracy of meter proportioning:

1. Material Quantity. Because percent asphalt in the job mix is specified on a weight (mass) basis, check the accuracy of the meter or pump by weighing a quantity of bituminous material at least equal to the quantity used in one batch (use approximately 2 tons (2 Mg) for continuous plants). During the test, ensure that the same material type and temperature used to produce the job mix is used to perform the test. If the temperature of the bituminous material varies more than approximately 15°F (8°C) under normal operating

conditions, perform the test at both the highest and the lowest temperatures to determine how the temperature change affects the quantity of asphalt delivered.

2. Bypass. The system used to deliver the bituminous material should be equipped with a bypass. Use this bypass to discharge the bituminous material into a weigh drum instead of the mixer. The bypass must be equipped with a throttle valve. Use the throttle to regulate the rate of flow through the meter or pump to achieve a back pressure similar to that under normal operating conditions.
3. Equipment. To weigh the asphalt, use a platform scale that has a capacity of 300 lbs (135 kg) and a sensitivity of 0.5 lb (0.25 kg). Also needed is a metal drum, or similar container, capable of holding an amount of asphalt in excess of the normal batch weight (mass) used in production.
4. Procedure. Use the following procedure to check the accuracy of meters and pumps:
 - a. Set the meter or pump to the quantity of bituminous material that is normally used to produce the job mix.
 - b. Measure the temperature of the material to ensure that it is approximately equal to the storage temperature during normal production.
 - c. Check the rate of discharge of asphalt into the mixer under normal operating conditions.
 - d. Shift the discharge of the meter or pump from the mixer to the bypass and let the bituminous material flow into a container until the piping is heated. Simultaneously, check the rate of discharge and adjust as necessary by means of the throttle valve to approximate the rate used during normal operating conditions.

- e. Weigh the empty drum or container accurately and record the weight (mass).
 - f. For continuous plants, record the reading of the continuous meter or revolution counter.
 - g. Operate the meter or pump so that the quantity discharged into the drum equals the batch weight (mass) of bituminous material.
 - h. Record the temperature of the material in the drum.
 - i. For continuous plants, record the final reading on the continuous meter or revolution counter.
 - j. Weigh the drum and its contents and subtract the weight (mass) of the drum.
 - k. Determine the difference between the weight (mass) of bituminous material actually discharged in the drum and the weight (mass) of bituminous material indicated by the meter or pump.
 - l. Find the percent error: Divide the difference in weight (mass) determined in Step k by the weight (mass) indicated by the meter or pump and multiply by 100.
5. Allowable Percent Error. The allowable percent error is 0.4% or less. If the percent error determined from initially performing the test procedure is greater than 0.4%, repeat the procedure in Item 4 above. If the percent error is again found to be greater than 0.4%, halt mix production until the Contractor or plant operator can resolve the problem. After the meter or pump has been adequately adjusted or repaired, repeat the test procedure in Item 4.
6. Material Quantity in Supply Tank. When recording test data, note the amount of bituminous material in the supply tank. The

results of tests made with a nearly full supply tank may be different from those of tests that are made when the tank is empty.

708.2.2 Water Meter

Calibrate the water meter by drawing off and measuring various sample quantities over the full range of water quantities required for mix production. The water meter should accurately measure the required quantity of water to within 1% of the quantity actually discharged and measured. If the meter fails to meet this criterion, inform the Contractor or plant operator. Repeat the test and verify calibration after the meter has been properly adjusted or repaired. Record all calibrations, verifications, and sensitivity results in the Plant Diary.

708.2.3 Admixture Dispenser

Test the admixture dispenser at frequent intervals during mixer operation to ensure that the proper amount of agent is being dispensed for each batch. Calibrate the admixture dispenser by drawing off and measuring various sample quantities over the full range of admixture agent required for mix production. The admixture dispenser should be able to accurately measure the required quantities of admixture agent to within 3% of the quantity actually discharged and measured. If the admixture dispenser fails to meet this criterion, inform the Contractor or plant operator. Repeat the test after the dispenser has been properly adjusted or repaired. Record the results of all calibrations, verifications, and sensitivity checks in the Plant Diary.